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PLECOPTERA OF HEADWATER CATCHMENTS IN THE FERNOW EXPERIMENTAL FOREST, MONONGAHELA NATIONAL FOREST, WEST VIRGINIA

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Abstract.—The Fernow Experimental Forest is a research facility of the U.S. Forest Service located on the Allegheny Plateau in the northern part of Monongahela National Forest in Tucker Co., WV. This 1474-ha experimental forest encompasses the entire drainage of Elklick Run, a 4th order tributary to the Black Fork of the Cheat River. As part of several ongoing studies of the ecology of streams in the Fernow Experimental Forest, we conducted a survey of adult aquatic insects in 6 of these small catchments. From this survey, we identified 27 species of Plecoptera including 1 species of Pteronarcyidae, 1 of Peltoperlidae, 1 of Taeniopterygidae, 2 of Capniidae, 7 of Leuctridae, 4 of Nemouridae, 5 of Chloroperlidae, 1 of Perlidae, and 5 of Perlodidae.

Key Words: Plecoptera, species list, Fernow Experimental Forest, West Virginia

The Fernow Experimental Forest is one of several experimental forest areas operated by the Northeastern Forest Experiment Station of the U.S. Forest Service for catchment-level research in forestry and watershed management. It is 5 km south of Parsons in Tucker County, West Virginia in the northern part of Monongahela National Forest (39°3′N, 79°40′W) (Fig. 1). Established in 1951, the 1474-ha experimental forest is in the Allegheny Plateau Province of the central Appalachians (Aubertin and Patric 1974) and includes the entire catchment of Elklick Run, a 4th order tributary of the Black Fork of the Cheat River. The experimental forest includes 9 gauged experimental catchments and several ungauged catchments (Fig. 1).

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Our research in the Fernow Experimental Forest on the effects of acid precipitation and the nontarget effects of the application of the forest pesticide, diflubenzuron, has included work on the macroinvertebrate communities of the 2nd order streams that drain several of these headwater catchments (Griffith and Perry 1991). Only two previous studies have produced surveys of streams in the Fernow Experimental Forest. Case (1983) collected kick samples of aquatic nymphs from Watersheds 1, 4, and 6 and three catchments outside the experimental forest. Harris (1973) collected adults with emergence traps and nymphs with an Eckman dredge from the weir ponds of Watersheds 1, 3, 4, 6, and 7. Both studies identified the insects primarily to genus. Also, little collecting has been done by other active Plecoptera researchers in this part of West Virginia (R. Kirchner, pers. comm.).

To facilitate ongoing research at the Fer-

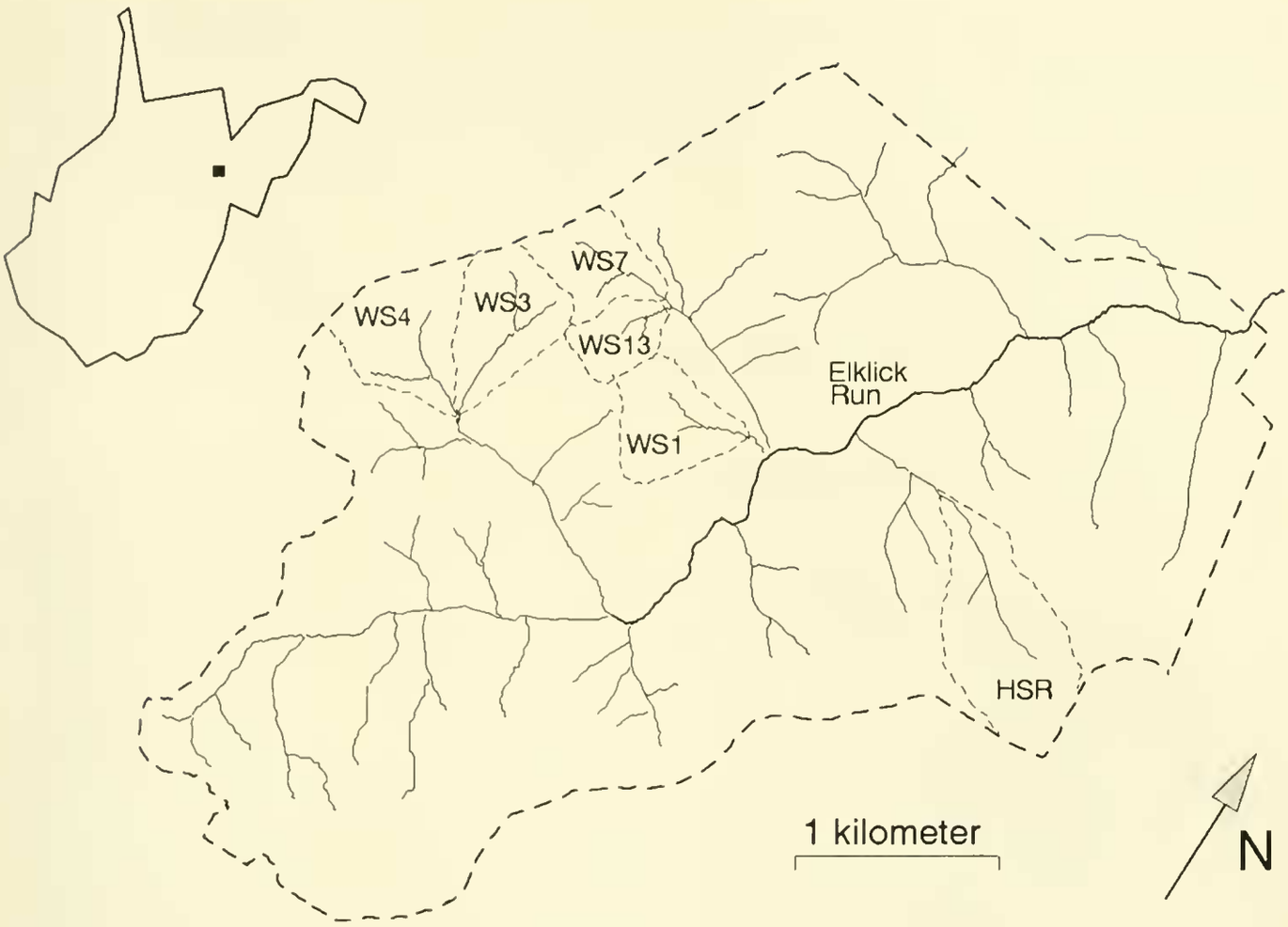

Fig. 1. Fernow Experimental Forest with the locations of study catchments.

now Experimental Forest, we conducted a survey of aquatic insects in the streams draining the catchments used in our present studies. From these collections, we present a species list of the Plecoptera.

Study Sites

The study sites include 1 ungauged and 5 gauged streams that drain 2nd order catchments in the Fernow Experimental Forest (Table 1). Watershed 1 (WS1), Watershed 3 (WS3), Watershed 4 (WS4), Watershed 7 (WS7), and Watershed 13 (WS13) drain gauged catchments on the north side of Elklick Run (Fig. 1) and are underlain by shale and siltstones of the Hampshire formation. Soils in the catchments are primarily Calvin silt loams with some Earnst silt loams

Table 1. Physical and chemical characteristics of study streams in the Fernow Experimental Forest, Tucker County, West Virginia.

	WS1	WS3	WS4	WS7	WS13	HSR
Order	2nd	2nd	2nd	2nd	2nd	2nd
Catchment Area (ha)	29.9	38.2	41.0	24.3	14.5	230.3
Mean Altitude (masl)	704	819	812	768	743	852
Last Logged	1958	1969	1910	1969	1910	1910
Mean Discharge (m^3/sec)	0.0070	0.0085	0.0097	0.0076	0.0045	0.0248
pH	6.16	6.09	6.02	6.18	6.14	7.53
Alkalinity (mg/l $CaCO_3$)	2.03	0.83	0.59	1.30	1.24	35.80

Table 2. Checklist of Plecoptera collected from streams in the Fernow Experimental Forest, Monongahela National Forest, West Virginia, 1989–1991.

	HSR	WS1	WS3	WS4	WS7	WS13
Order Plecoptera						
Suborder Arctoperlaria						
Group Euholognatha						
Superfamily Nemouroidea						
Family Taeniopterygidae						
Subfamily Brachypterinae						
Strophopteryx appalachia Ricker and Ross			X			
Family Nemouridae						
Subfamily Amphinemourinae						
Amphinemoura nigritta (Provancher)	X	X	X	X	X	
**A. wui* (Claassen)		X	X	X	X	X
Subfamily Nemourinae						
Ostrocerca complexa (Claassen)		X	X	X		X
**Soyedina washingtoni* (Claassen)	X		X	X		
Family Leuctridae						
Subfamily Leuctrinae						
Leuctra alexanderi Hanson				X		X
L. grandis Banks	X		X	X		X
L. ferruginea (Walker)	X	X	X	X	X	X
L. sibleyi Claassen	X		X	X	X	X
L. tenella Provancher		X	X	X		X
L. truncata Claassen	X	X	X			X
Paraleuctra sara (Claassen)				X		
Family Capniidae						
Allocapnia frisoni Ross and Ricker			X	X		
Paracapnia angulata Hanson	X	X	X			
Group Systellognatha						
Superfamily Pteronarcyoidea						
Family Pteronarcyidae						
Pteronarcys biloba Newman			X			
Superfamily Peltoperloidea						
Family Peltoperlidae						
Subfamily Peltoperlinae						
Peltoperla arcuata Needham	X	X	X	X	X	X
Superfamily Perloidea						
Family Perlodidae						
Subfamily Isoperlinae						
Isoperla slossonae (Banks)	X	X	X	X	X	X
**Isoperla* sp. A		X	X	X	X	X
Subfamily Perlodinae						
Malirekus hastatus (Banks)	X		X			
Remenus bilobatus (Needham and Claassen)			X			
Yugus bulbosus (Frison)	X	X	X	X	X	X
Family Perlidae						
Subfamily Acroneurinae						
Acroneuria carolinensis (Banks)	X					

Table 2. Continued.

	HSR	WS1	WS3	WS4	WS7	WS13
Family Chloroperlidae						
Subfamily Chloroperlinae						
Alloperla aracoma Harper and Kirchner	X					
A. usa Ricker	X	X	X	X		
Suwalia marginata (Banks)	X	X				
Sweltsa lateralis (Banks)	X		X	X	X	X
S. onkos (Ricker)	X	X	X	X		X

* New state record for West Virginia.

(Losche and Beverage 1967). WS4 and WS13 are reference catchments that have undergone little disturbance since about 1910, except for the removal of dead American chestnuts (*Castanea dentata* (Marsh.) Borkh.) in the 1940's (Aubertin and Patric 1974). They currently support mature forest stands dominated by red oak (*Quercus rubra* L.), sugar maple (*Acer saccharum* Marsh.), and American beech (*Fagus grandifolia* (Ehrh.). WS1, WS3, and WS7 are experimental catchments that were last logged in 1958, 1969, and 1969, respectively. WS1 supports a 30-year-old forest stand dominated by yellow poplar (*Liriodendron tulipifera* L.), red maple (*Acer rubrum* L.), and black birch (*Betula lenta* L.). WS3 and WS7 support 20-year-old forest stands dominated by black cherry (*Prunus serotina* Ehrh.) and black birch (J. Kochenderfer, U.S. Forest Service, pers. comm.).

The North Fork of Hickman Slide Run (HSR) drains an ungauged catchment on the south side of Elklick Run (Fig. 1) and is underlain by limestones and shales of the Greenbriar and Mauch Chunk formations. Soils in the catchment are primarily Calvin silt loams and Belmont stony loams (Losche and Beverage 1967). Little research has been conducted on catchments on the south side of the Fernow Experimental Forest, and HSR has undergone little disturbance since about 1910, except for the removal of dead American chestnuts in the 1940's (Aubertin and Patric 1974). HSR currently supports a mature forest stand similar to that of WS4 and WS13. Because of the presence of limestone in its catchment, HSR is characterized by higher pH and alkalinity than the other streams (Table 1).

Materials and Methods

The survey was conducted primarily with emergence traps modified from the WEEK design of LeSage and Harrison (1979). These collections were supplemented by periodic light trapping with blacklight traps and collections by hand when adults were observed during other sampling. One species, *Remenus bilobatus* (Needham and Claassen), has not been collected in the adult stage and was identified from nymphs in benthic samples.

Trapping of emerging insects on WS3 and WS4 began in June 1989. Trapping of emerging insects in WS4 continued through June 1991, whereas the emergence trap on WS3 was removed in May 1990. Trapping of emerging insects on HSR started in May 1990 and was continued through June 1991. Emergence traps on WS1, WS7, and WS13 were placed in May 1990 and trapping continued through June 1991 except for a period in December 1990 and January 1991. Sampling intervals varied from 1 week to 4 weeks.

All collected material was preserved in 85% ethanol. Voucher specimens have been placed in the collection of the West Virginia Cooperative Fish and Wildlife Research Unit in the Division of Forestry at West Virginia University. Specimens of *Soyedina*

washingtoni (Claassen) have been placed in the entomology collection of the Smithsonian Institution.

Results and Discussion

We collected 27 species of 19 genera and 9 families of Plecoptera from headwater streams in the Fernow Experimental Forest (Table 2). Tarter and Kirchner (1980) reported a total of 106 species of 37 genera and 9 families of Plecoptera for the entire state of West Virginia. By confining our survey to these headwater reaches, some species which may occur in larger streams in the Elklick catchment were missed. A collection from Elklick Run produced adults of the nemourid, *Prostoia similis* (Hagen).

We collected 2 species that were new records for the state of West Virginia: *Soyedina washingtoni* and *Isoperla* sp. A. Our collections of *S. washingtoni* from the Fernow Experimental Forest seem to represent the southern-most records of this species, which is found primarily in New England (Hitchcock 1974). *Isoperla* sp. A is an undescribed species in the *Isoperla montana* group which has been previously reported from the piedmont of Virginia, North Carolina, and South Carolina (S. W. Szczytko, University of Wisconsin, La Crosse; pers. comm.). Our collections represent an extension of the range of this species into the Appalachians.

West Virginia appears to be an area of transition for the distribution of many species of Plecoptera in the Appalachians. Tarter and Kirchner (1980) suggest that West Virginia was a glacial refuge, and our collections include a number of species whose distributions occur largely to the north of West Virginia. In addition to *Soyedina washingtoni,* species in this group include *Paracapnia angulata, Ostrocerca complexa, Sweltsa onkos, Peltoperla arcuata,* and *Isoperla slossonae.* A number of other species, however, exhibit more southerly distributions including *Leuctra alexanderi, Amphinemoura wui, Alloperla usa,* and *Yugus bulbosus* (Stark et al. 1986).

A number of species exhibited patterns of presence or absence between the streams. Most species that were collected in only 1 or 2 streams, particularly those emerging in the winter, were probably under-collected. Examples of this include *Allocapnia frisoni* and *Paraleuctra sara.* Others such as *Strophopteryx appalachia* and *Suwallia marginata* are probably rare. *Pteronarcys biloba* is common in downstream reaches of Elklick Run but has not been collected in benthic samples from the study reaches, and we probably collected an adult which had flown from downstream (M. Griffith, pers. obser.).

One important pattern may be the presence or absence of species in the more alkaline stream, HSR, that are absent from or occur in the other streams. *Acroneuria carolinensis* and *Alloperla aracoma* were collected only from HSR. *Amphinemoura wui, Ostrocerca complexa, Leuctra tenella,* and *Isoperla* sp. A were not collected from HSR but were found in several of the other streams. These observations are tentative because we only observed emergence from one alkaline stream, but they suggest that water chemistry may be influencing the distribution of some species of Plecoptera in these headwater streams. Research has shown that some Plecoptera are resistant to low pH associated with the problem of acid precipitation, and Plecoptera tend to dominate the invertebrate community of such streams. Simpson et al. (1985) found *Leuctra ferruginea* to be the dominant species in low pH streams in the Adirondacks. Perlic (1985) found *Amphinemoura* sp. and *Leuctra* sp. to be dominant in low pH streams in the Laurel Highlands of Pennsylvania just to the north of the Fernow. There are few other studies which have compared stonefly species assemblages between neutral and more alkaline streams, but Plecoptera are often replaced as the dominant shredder in alkaline streams in the Appalachians by the amphipod, *Gammarus minus* (Glazier and Gooch 1987).

Another pattern may be the presence of

Leuctra alexanderi only in the two streams draining the control catchments, WS4 and WS13. This suggests that catchment management history may also influence the distribution of some species of Plecoptera in these streams.

In general, a number of factors may influence the distribution of Plecoptera between streams even within a small area. Unfortunately, most researchers work only with the nymphal stage, for which identification to the species level is often impossible. This may obscure the effect of environmental factors on these species assemblages. Surveys such as this study may give insights into more subtle changes in species assemblages between streams. Also, the species lists they produce provide a basis for recognition of species in benthic studies which will improve research conducted in established research areas such as the Fernow Experimental Forest.

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